RAFFERTY-ALAMEDA PROJECT

ENVIRONMENTAL IMPACT STATEMENT

Souris Basin Development Authority

CHAPTER 10

NATURAL VEGETATION

RAFFERTY/ALAMEDA ENVIRONMENTAL IMPACT STATEMENT

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NATURAL VEGETATION

INTRODUCTION

The proposed Project is located in the Mixed Grass Prairie Ecodistrict, the largest of the Grassland Ecodistricts in Saskatchewan (Harris **et al.** 1983). The climate of this ecodistrict is described as semi-arid. Mean annual precipitation is 375 mm, of which 64% falls from May to September. The main characteristic plant species are typical mixed prairie grasses. These include speargrasses (**Stipa spp.**), wheatgrasses (**Agropyron spp.**) and blue grama (**Bouteloua gracilis**).

A vegetation baseline study conducted in the Estevan region in conjunction with the proposed Rafferty and Alameda Reservoirs was based on a field program conducted in July, 1984. Field data thus obtained were supplemented with existing information from various sources as well as by air photo interpretation.

The main objectives of the study were:

- to document the flora of the area;
- to document the spatial distribution of plant communities in the form of an ecological land map relating plant communities to the prevalent land forms;
- to describe the plant communities in terms of species composition and landscape characteristics; and
- to provide an estimate of the yield and condition of the rangeland.

METHODS

1 FLORA

.1 Rafferty

A floristic survey of the Rafferty region was completed in July, 1984 to document the species of plants found in the main vegetation communities in the area. Emphasis was placed upon surveying the areas of potential direct impact.

Twenty-seven locations (Figure 1) representative of the main physiognomic types, were selected on the basis of air photo interpretation. Those were examined in the field. (Nine of these were directly associated with the proposed Shand Power Station.) At each location several sites representing the various segments of the landscape were surveyed and a list of all vascular plants present was prepared. Results of previous studies were also considered in this study (Maher et al. 1979, Hudson 1977, Noble and Flory 1978). The presence of rare and endangered plant species was determined by reference to Maher et al. (1979).

.2 Alameda

Field surveys were not carried out in the Alameda Reservoir area or along the Souris River downstream from the Shand site to the U.S. Border. Air photo interpretation and previous reports were used to provide preliminary data; more comprehensive material will be presented to Saskatchewan Environment at a later date following the 1987 field investigations.

2 ECOLOGICAL LAND MAP

An ecological land map (biophysical map) relating the spatial distribution of plant communities to landforms, was prepared on the basis of air photo interpretation and field checks carried out in July, 1985. Land types were based partly on Stelfox (1979).

The areal extent of each land type in the proposed Rafferty Reservoir area was delineated and measured on large-scale (1:10,500) air photos, while work on the Alameda Reservoir area was carried out on 1:20,000 air photos.

3 PLANT ASSOCIATIONS

.1 Rafferty

Eighty-five stands of natural vegetation, representing all site conditions, were selected from air photo mosaics (1:50,000) and evaluated in the field. In communities dominated by woody species (trees and shrubs) and

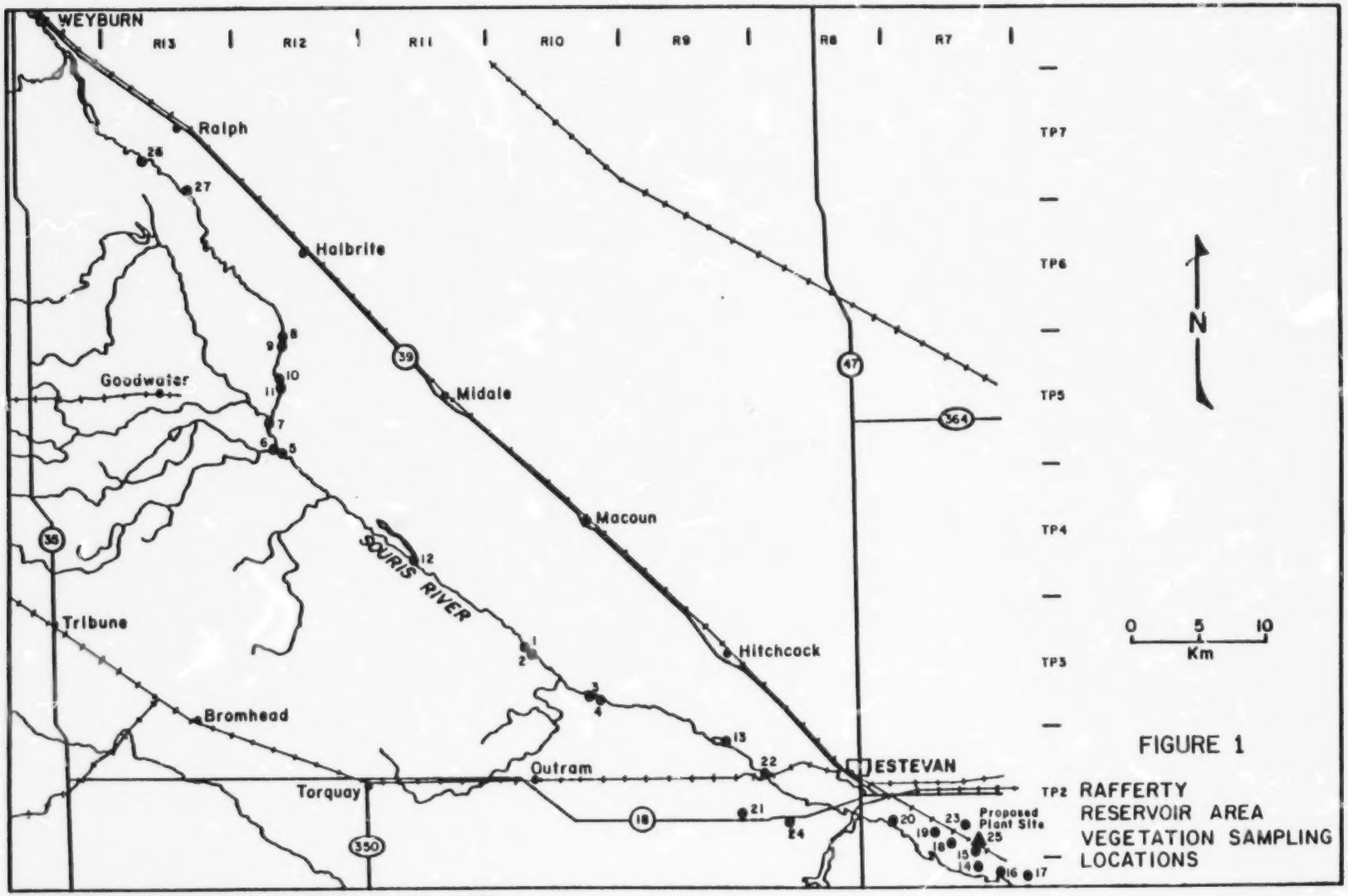


FIGURE 1

RAFFERTY RESERVOIR AREA VEGETATION SAMPLING LOCATIONS

SOURCE: SASKATCHEWAN RESEARCH COUNCIL, 1985
No. E-902-8-E-85

other streamside communities, the following cover/relative abundance scale was used:

5	75% cover
4	51-75% cover
3	26-50% cover
2	5-25% cover
1	5% cover
+	several individuals, but cover less than 1%

For the grassland communities it was decided that biomass was a more appropriate method of assessing the status of the vegetation because it would be more useful in evaluating grazing capacity and range condition.

Vegetation stands were grouped according to land types or sites. Further grouping on the basis of species composition similarities yielded the plant association classification.

.2 Alameda

Existing data were used to characterize the natural vegetation in the Alameda Reservoir area.

4 RANGE CONDITION AND STANDING CROP

Range condition in the Rafferty region was determined in pasture land throughout the proposed development area by comparing the percentage composition by weight estimates for each range site with the potential natural vegetation for that site. Evaluation of rangeland in the Alameda region was based on available literature.

Productivity (as indicated by maximum standing crop) of the area was determined by clipping vegetation close to the ground. At the end of July, the standing above ground biomass within 0.25 m^2 plots in ungrazed grassland areas which were rated in good to excellent range condition according to the guide developed by Abouguendia **et al**. (1982), was assessed. Harvested material was air dried and weighed to determine yield per unit area.

RESULTS AND DISCUSSION

1 GENERAL

.1 Rafferty Region

With the exception of the floodplains associated with the Souris River Valley where tree types and wetlands are found, the natural vegetation of the area is a mosaic of grass and shrub types. A large portion of the region is cultivated land and the remaining areas of natural vegetation occupy sites that are too stony, too steep or too wet to cultivate. Strip mining for coal is extensive at present in the Estevan area and attempts to undertake coal spoil revegetation are being met with varying degrees of success.

.2 Alameda Region

The natural vegetation of the Alameda area is generally similar to that of the Rafferty area except that the former has more aspen in the upland.

2 FLORA

.1 Rafferty

The natural flora of the Rafferty area is representative of the grasslands of southern Saskatchewan. The semi-arid climate maintains a mixed grass prairie association with its corresponding species assemblage. The river valley provides habitats which differ from those of the surrounding till plains and allows encroachment of species present in the more humid climatic zones to the east. Also, a few species of plants representative of the neighboring True Prairie in southern Manitoba occur in the area of study.

A total of 154 taxa of vascular plants has been found in the Rafferty study area by Abouguendia (1986) (See Appendix 1). While this number does not represent the total flora of the area, it includes most of the species occurring in the various habitats in the area. One hundred and forty-six of the taxa listed were encountered in the field work of this project while eight additional species were reported in a study of the Midale community pasture (Noble and Flory 1978). Three other species have been listed for the area by Maher **et al.** (1979).

Of the species identified during field investigations in the study area there were 3 trees, 13 shrubs, 98 forbs, 3 cacti, 32 grasses, 4 sedges and 1 spike-moss.

Field surveys were not carried out in the Alameda Reservoir area; an examination of available literature indicated that the flora in that area is similar to that of the Rafferty area.

3 RARE OR ENDANGERED SPECIES

Many species considered rare in Saskatchewan occur in the Souris River Valley. These represent elements of eastern North American flora which extend into the province along the river valley. However, in the Study Area the majority of these species are restricted to that portion of the river valley from the city of Estevan eastwards.

Five species are reported to occur in the Souris River valley within the proposed Rafferty Reservoir area (Maher **et al.** 1979, Hudson 1977). The Saskatchewan records for these species are given by Abouguendia (1986). Two species, big bluestem (**Andropogon gerardi**) and side oats grama (**Bouteloua curtipendula**), were found on the valley slope approximately two miles upstream from the proposed Rafferty dam site. These are grass species of the True Prairie association. The side oats grama was also found along the river valley within the Midale SDA community pasture (Noble and Flory 1978 and P. Flory pers. comm. 1985).

Other rare species which should occur in the study area according to Maher **et al.** (1979) include Jerusalem artichoke (**Helianthus tuberosus** var. **subcanescens**), purple locoweed (**Oxytropis lambertii**), and blue skullcap (**Scutellaria lateriflora**). Jerusalem artichoke is listed as occurring from Goodwater to Gainsborough in shore thickets and may occur in the streamside forest to the south of Halbrite. Purple locoweed was reported to occur on the dry slopes of the Souris (between Goodwater and Estevan) and Qu'Appelle river valleys. Blue skullcap favours damp meadows and moist stream shores in the eastern section of the province. This species is reported along the Souris River downstream from Weyburn to as far as Carievale.

Rare or endangered plant species had not been previously reported for the proposed Alameda Reservoir area (Maher **et al.** 1979). Additional field surveys

were needed to determine if any such species occur in this area; these are being undertaken in 1987.

Preliminary field surveys (EMA 1987) have indicated that big bluestem is evident near the proposed Alameda dam site and in the Souris Valley east of Estevan. Side oats grama has not been located within the Alameda Reservoir area but it is reported in the Moose Mountain Creek Valley further downstream and within the Souris Valley. Full results of the 1987 field investigations will be provided to Saskatchewan Environment with other Alameda baseline data as studies are completed.

4 ECOLOGICAL LAND MAP

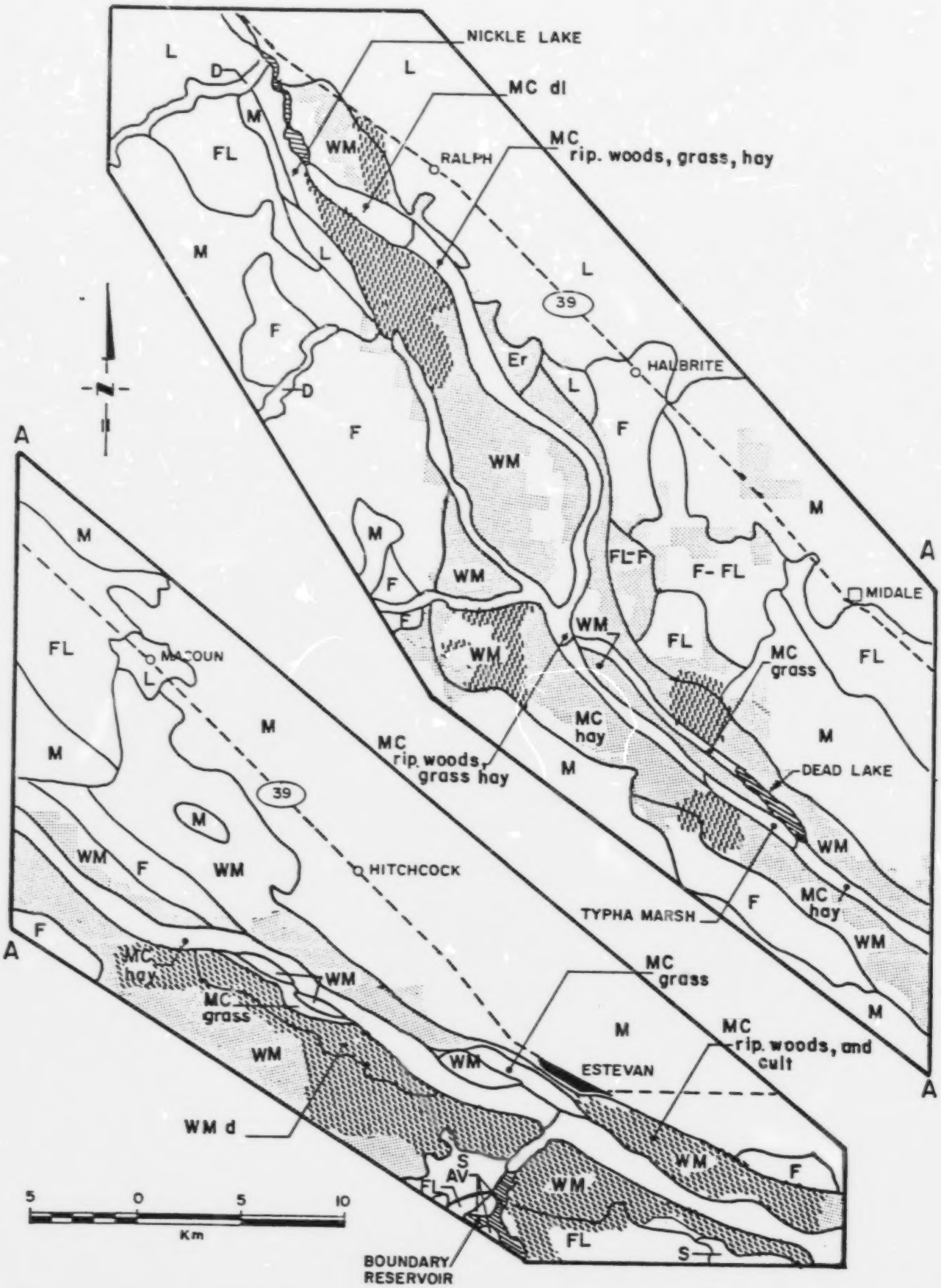
.1 Rafferty Reservoir Area:

The general ecological land map of the Rafferty area is shown in Figure 2. The main land types identified are as follows:

- Moraine
- Washed (eroded) Moraine (including a subclass of dissected land)
- Fluvial
- Fluvio-lacustrine
- Lacustrine
- Meltwater channel
- Low relief drainage channels
- Mine spoils

Within these land types the following vegetation types have been delineated:

- A speargrass -blue grama- wheatgrass association with little shrub development;
- A speargrass -blue grama- wheatgrass association with strong development (up to 50% of the total area) of shrub cover composed mainly of western snowberry (**Symphoricarpos occidentalis**) and to a lesser extent, wolf willow (**Elaeagnus commutata**);
- Riparian woods - tall shrub and Manitoba maple (**Acer negundo**) woodland bordering the river;
- Haylands - perennial forage crops of alfalfa-brome mixtures;


NICKLE LAKE
MC dl
MC
rip. woods, grass, hay
RALPH
HALBRITE
MIDALE
MACOUN
HITCHCOCK
DEAD LAKE
TYPHA MARSH
ESTEVAN
BOUNDARY
RESERVOIR
MC
grass
MC
hay
MC
rip. woods,
grass hay
MC
rip. woods, and
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39
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Landforms

M = Moraine - lands predominantly unsorted glacial till.

WM = Washed Moraine - moraine scoured by glacial meltwater resulting in loss of fine materials from till (d) - dissected.

F = Fluvial - coarse textured glaciofluvial deposits.

FL = Fluvial Lacustrine - sandy glacial fluvial and lacustrine (lake) deposits.

L = Lacustrine - fine textured glacial lake deposits.

MC = Meltwater Channel - glacial spillway often with steep rocky slopes and alluvial deposits in channel bottom if occupied by a postglacial stream.

- grass - upland grass community on higher terraces of valley floor.
- rip. woods - streamside hardwood forest.
- hay - perennial forage crops raised on alluvial flats
- cult. - alluvial flats utilized for production of annual crop species.

D = Drainage area of low relief and usually a result of postglacial development.

Er = Eroded Slopes - contain areas of immature, successional vegetation.

S = Mine spoils - in various stages of succession.

Typha Marsh (Cattail dominated marshland).

Speargrass-blue grama-wheatgrass association with a strong shrub component occupying >30% of the area.

Speargrass-blue grama-wheatgrass association with a weak shrub component.

Cultivated lands.

Water.

AV = Alluvium - fine textured alluvial deposits.

FIGURE 2

ECOLOGICAL LAND MAP
RAFFERTY RESERVOIR

TABLE 1

Areas of Fifteen Ecological and Cultural Land Types*
Occurring Within The Proposed Rafferty Reservoir

Section of Reservoir	Areas Within Ecological Land Units[a] (ha)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
1. Rafferty Dam to Macoun grid	58	-	608	104	35	324	87	10	5	29	82	37	15	-	14	1408
2. Macoun grid to Dead Lake dam	66	-	242	338	84	344	106	-	4	38	ol	26	4	-	1	1314
3. Dead Lake dam to Junction with Roughbark Creek	17	12	191	-	86	414	139	1	-	158	177	31	16	25	23	1290
4. Souris River from Roughbark Creek to Halbrite grid	38	78	108	76	128	64	24	1	-	-	29	6	8	-	-	560
5. Souris River west of Halbrite to Nickle Lake	3	-	-	-	1	-	-	-	-	-	14	-	-	-	-	18
6. Roughbark Creek	34	18	11	-	162	84	-	-	-	-	16	-	15	-	-	340
TOTAL AREAS	216	108	1159	518	496	1230	357	12	9	225	379	100	58	25	38	4930

[a] = Units as follows:
1 - Streamside - graminoids, forbs and short shrubs
2 - Streamside - maple and tall shrub
3 - Alluvial floodplain - haylands
4 - Alluvial floodplain - annual crops
5 - Alluvial floodplain - native grass/shrub
6 - Valley slope - grass/shrub
7 - Valley slope - shrub (snowberry-wolf willow)/grass
8 - Valley slope - aspen
9 - Till plain - grass/shrub
10 - Marsh - cattail dominant
11 - Open water - lake and slough - nonvegetated
12 - Oxbow wetland - temporary wetland dominated by graminoids (grasses and grass-like plants)
13 - Disturbance areas - gravel extraction, farm yards
14 - Recreational areas - golf course, picnic sites
15 - Open water - submerged aquatics

*Measurements up to the 550 metre elevation (0.5m above the Initial Operating Level of 549.5 to account for initial shoreline erosion)

- o Cultivated lands;
- o Marshland - dominated by cattail (**Typha latifolia**) and bulrush (**Scirpus spp.**); and
- o Disturbance communities - vegetation communities in early successional stages.

The majority of the area near the development sites is occupied by native vegetation. The Souris River occupies a glacial meltwater channel within the study area. This channel has steep, eroded slopes supporting a mosaic of grass and shrub types. The valley bottom has been altered by the Souris River which has meandered across the valley since glaciation, leaving deep alluvial deposits over most of the valley. This meandering of the river has also left oxbow channels with depths varying from slight depressions which have developed a meadow type of community, to near river-like channels occupied by marsh type vegetation communities. Where the moisture regime is adequate, a forest vegetation type is found on the floodplain.

Because of the great diversity of physical and biological features within the valley, this area cannot be mapped at a practical scale to show all of the biophysical features. The area has been complexed for mapping purposes and detailed areal measurements of 15 biophysical units within the proposed Rafferty Reservoir area were made from large scale air photos (1:10,500). These are listed in Table 1. Figure 3 graphically illustrates these ecological/cultural land types.

Figure 4 indicates the areal extent of haylands and annual croplands within the reservoir. A total of 1678 ha of haylands and cropland will be affected by the reservoir. This represents approximately one-third of the total reservoir area.

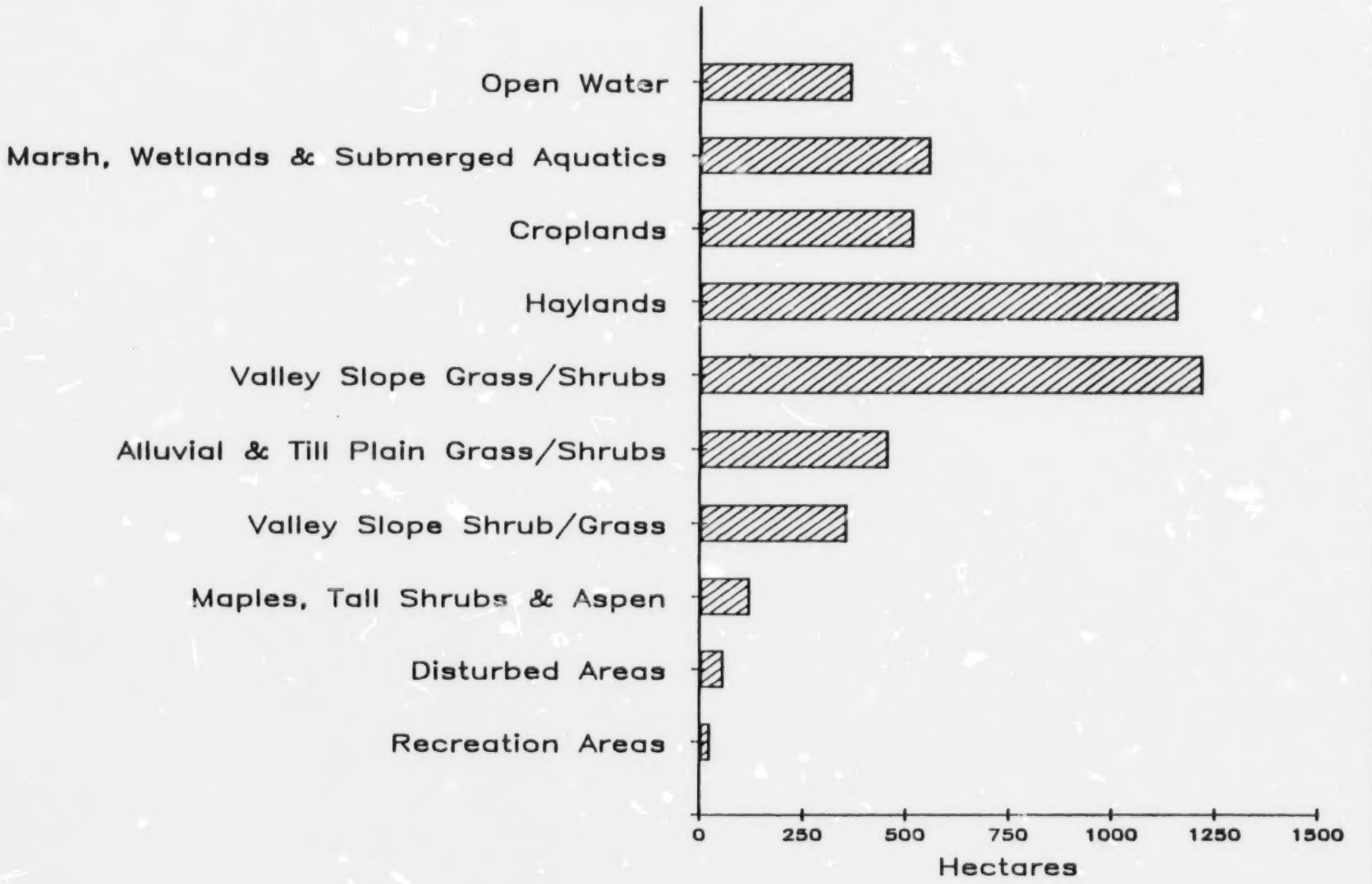
.2 Alameda Reservoir

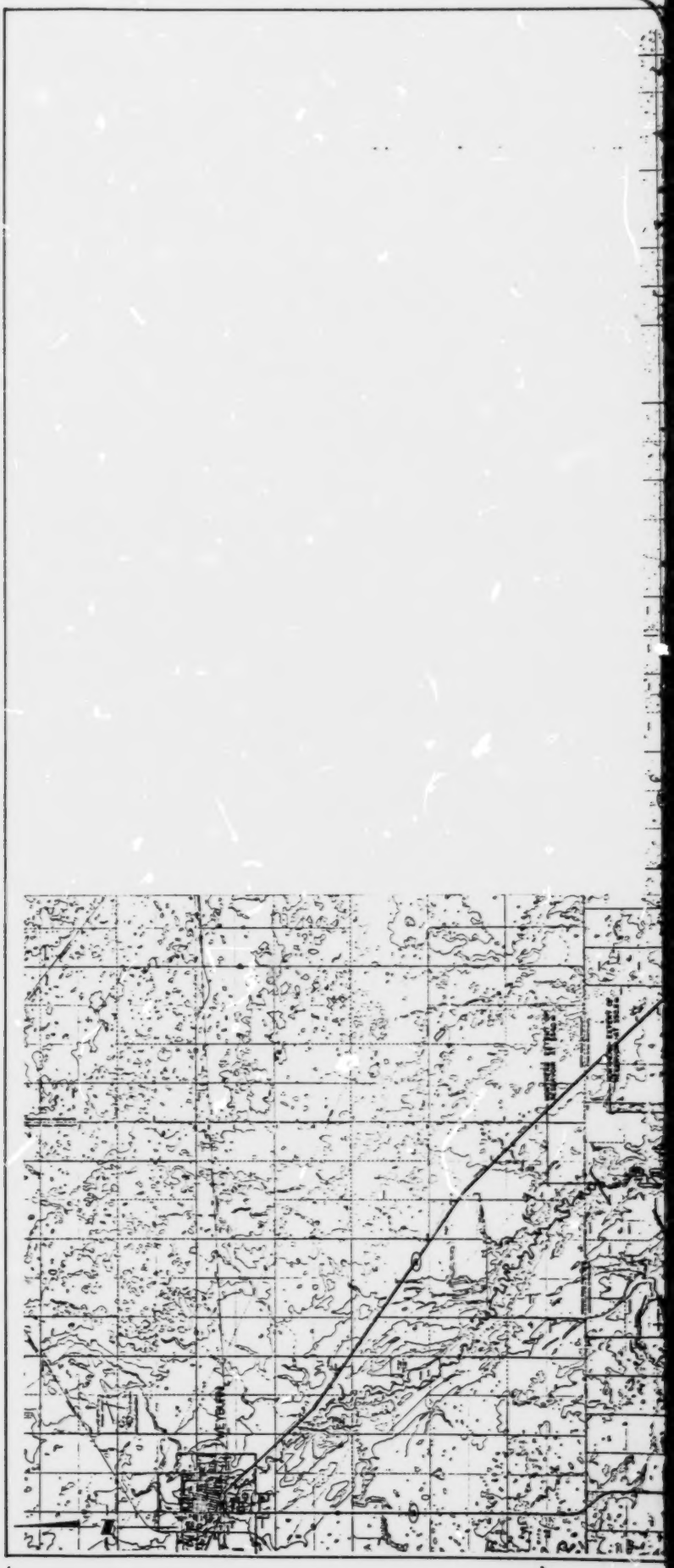
The proposed Alameda Reservoir along Moose Mountain Creek is within the Souris Plains of the Central Saskatchewan Plains of the Saskatchewan Plains Region (Richards and Fung 1969, Stelfox 1979). This is predominantly a till plain with some variety provided by hummocky and ribbed ground moraine and local lake plains.

Moose Mountain Creek is a glacial meltwater channel land system characterized by a "U"-shaped valley, eroded valley walls in many locations and

Ecological / Cultural Land Types
Rafferty Reservoir (hectares)

FIGURE 3





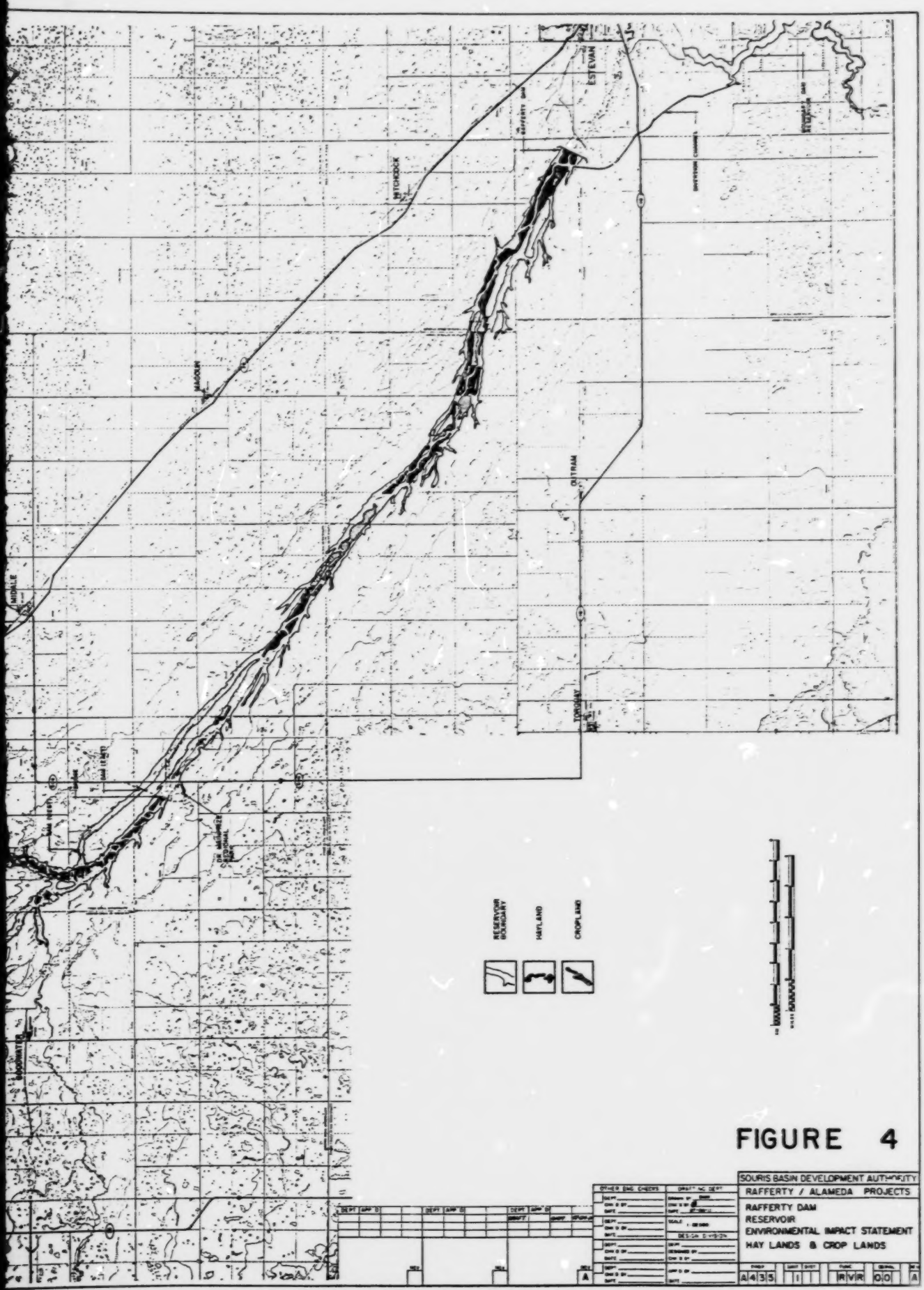


FIGURE 4

SOURIS BASIN DEVELOPMENT AUTHORITY
RAFFERTY / ALAMEDA PROJECTS
RAFFERTY DAM
RESERVOIR
ENVIRONMENTAL IMPACT STATEMENT
HAY LANDS & CROP LANDS
A435 RVR 00 A

with alluvial deposits and streams along the valley flood plain (Stelfox 1979). Both erosional and depositional features are present. There are frequent areas of fairly steep valley walls with eroded "coulees" which can extend a considerable distance from the main valley. The channel floor is generally flat and characterized by "underfit" drainages and fine-to-moderate textured alluvial deposits. In some areas along the lower portion of Moose Mountain Creek, there are more coarse, fluvial deposits. The slip-off slopes on the inside curves of channel meanders often contain deposits of sand and gravel. Consequently Moose Mountain Creek can be considered a meltwater channel-fluvial land system. Surface drainage is the alluvial deposits on the valley floor in the area of the slow, meandering creek channel and areas of wetlands interspersed along the channel.

The tributary channels which branch out to the west of Moose Mountain Creek, immediately upstream of the proposed dam site, are characterized by a fluvial land system (Stelfox 1979). These tributaries are characterized by shallower valleys with gentler slopes. The coarse-textured, sandy to gravelly deposits are glacio-fluvial in origin and are generally characterized by excessive drainage even though the groundwater level may be near the surface.

Cover types were delineated on 1:20,000 scale air photo mosaics. The areal extent of the various types has been measured and is shown on Figure 5 and in Table 2.

Natural vegetation covers more than 90% of the proposed Alameda Reservoir area. The main agricultural land use of the area is grazing by livestock and wildlife. Grazing capacity of such rangeland averages 1.4 Animal Unit Months per hectare (AUM/ha). Most of the reservoir area, particularly the lower floodplains, is subject to frequent flooding in the spring. Cultivated land (hay and crop) is estimated to be less than 10%. Hay production is estimated to be 1,350 kg/ha year. Wheat yield is estimated to average 38.3 bu/ha (15.5 bu/acre).

.3 Souris Valley (Downstream from Rafferty)

Studies are currently underway to map the natural vegetation for this area. Information will be provided to Saskatchewan Environment as soon as these studies are completed.

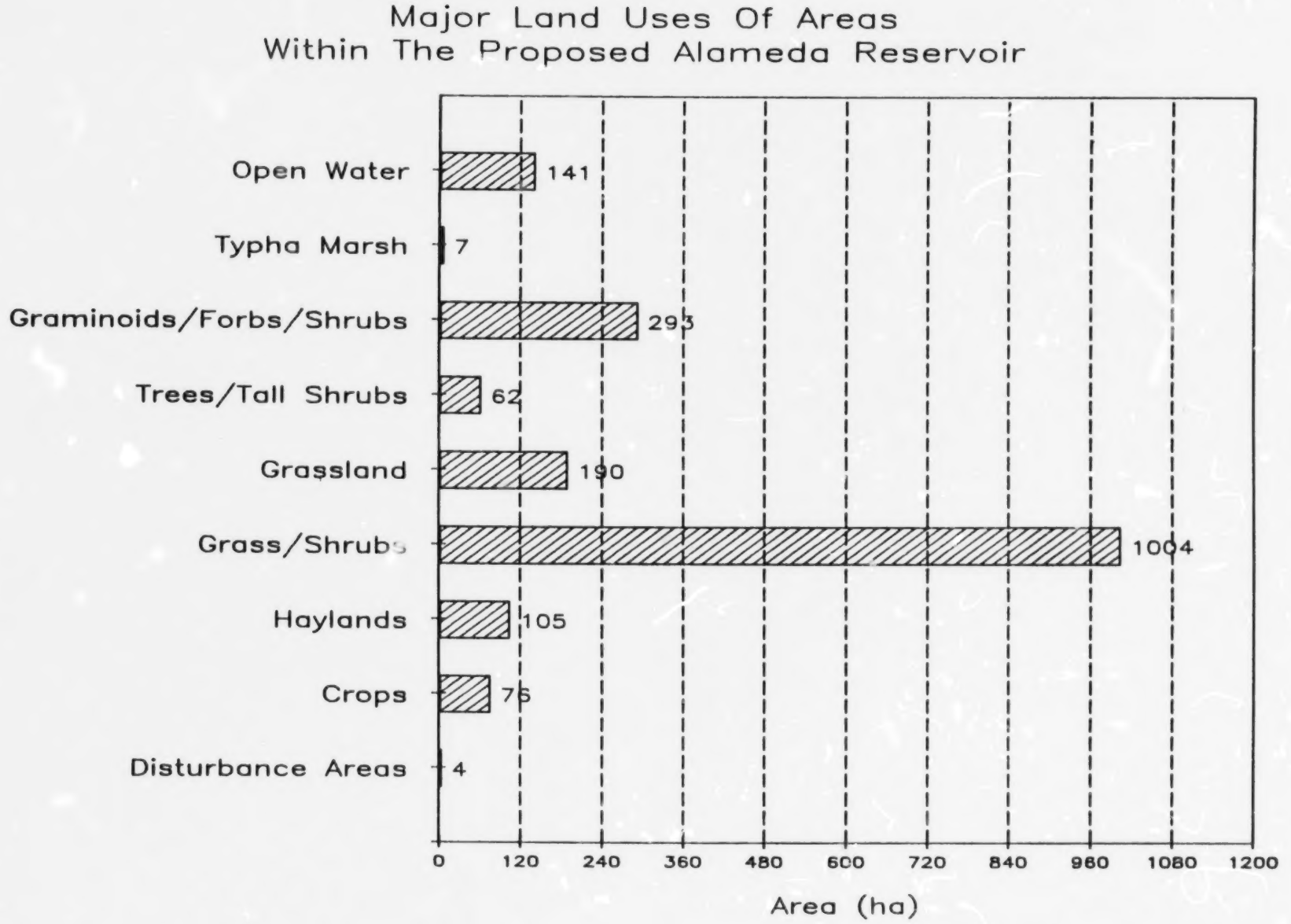

Major Land Uses Of Areas
Within The Proposed Alameda Reservoir
Open Water
141
Typha Marsh
7
Graminoids/Forbs/Shrubs
293
Trees/Tall Shrubs
62
Grassland
190
Grass/Shrubs
1004
Haylands
105
Crops
76
Disturbance Areas
4
0
120
240
360
480
600
720
840
960
1080
1200
Area (ha)

FIGURE 5

TABLE 2

Areal Extent of the Various Cover Types
within the Proposed Alameda Reservoir (to Flood Level 579 metres)

Cover Type	Area (ha)				
	Main Channel	Tributary	Dam	Total	(%)
Lower Floodplain					
Open Water	136.2	1.9	3.3	141.4	(7.5)
Marsh	4.7	1.8	-	6.5	(0.3)
Graminoids, Forbs, Shrubs	139.5	81.6	-	221.1	(11.7)
Trees, Tall Shrubs	3.3	5.6	-	8.9	(0.5)
SUBTOTAL	283.7	90.9	3.3	377.9	(20.1)
Upper Floodplain					
Grassland	60.0	5.9	2.9	68.8	(3.6)
Shrubs	6.0	-	2.3	8.3	(0.4)
Trees	5.4	-	-	5.4	(0.3)
Grass/Shrub	101.9	3.7	1.2	106.8	(5.7)
Hayland	38.3	-	-	38.3	(2.0)
Crop	30.2	-	2.2	32.4	(1.7)
SUBTOTAL	241.8	9.6	8.6	260.0	(13.8)
TOTAL FLOODPLAIN	525.5	100.5	11.9	637.9	(33.9)
Valley Slope					
Grassland	60.4	15.7	-	76.1	(4.0)
Shrubs	62.6	0.8	-	63.4	(3.4)
Grass/Shrubs	658.6	209.3	7.8	875.7	(46.5)
Trees	41.3	2.3	4.3	47.9	(2.5)
Hayland	49.0	-	-	49.0	(2.6)
Crop	-	-	-	-	
TOTAL VALLEY SLOPE	871.9	228.1	12.1	1112.1	(59.1)
Upland					
Grassland	34.6	8.3	2.2	45.1	(2.4)
Shrubs	-	-	-	-	
Grass/Shrubs	8.0	13.7	-	21.7	(1.2)
Trees	-	-	-	-	
Hayland	17.4	-	-	17.4	(0.9)
Crop	42.3	0.4	0.9	43.6	(2.3)
TOTAL UPLAND	102.3	22.4	3.1	127.8	(6.8)
DUGOUT	0.0	1.5	0.0	1.5	(0.1)
FARMYARD	2.2	0.5	0.0	2.7	(0.1)
TOTAL AREA	1501.9	353.0	27.1	1882.0	

5 PLANT ASSOCIATIONS

.1 Rafferty Region

The floristic composition of the seven vegetation communities occurring in the Rafferty area is presented in this section.

i) Upland Grassland

The Estevan area falls within the Mixed Prairie Association of the North American grassland formation however, its proximity to the True Prairie Association is reflected in the presence of elements from the latter in certain microclimatically favourable sites. These species occur as scattered individuals within the mixed-grass communities and do not form a recognizable True Prairie Association.

The mixed-grass prairie in the study locale is dominated by two community types: the Speargrass-Wheatgrass community and the Speargrass-Blue grama-Wheatgrass community (Coupland and Rowe 1969). During the 1984 field survey it was noted that blue grama was present at most sites in a much larger proportion than is normally expected for this type of grassland. In a series of dry years, the abundance of blue grama in grasslands tends to increase at the expense of the wheatgrasses (Coupland 1973). Heavy grazing by livestock also favours the development of blue grama over the wheatgrasses. It is the most likely cause for this shift in species composition as the dry summers at Estevan have tended to be of low frequency. Two ungrazed sites near Estevan have high levels of wheatgrass and speargrass with little blue grama, further supporting this hypothesis.

Because of the abundance of blue grama in grazed sites in the samples obtained in 1984, the upland grassland sites have been grouped into one type (Table 3); i.e. the Speargrass-Blue grama-Wheatgrass community. In a series of more favourable years and with reduced grazing pressure, recovery toward the more typical species composition would be expected.

ii) Upland Shrub

Within the upland grass community, an upland shrub community dominated by western snowberry occurs in depressions which have a more favourable moisture regime. Kentucky bluegrass (**Poa pratensis**) appears to be the dominant grass on these sites although the wheatgrasses and speargrasses

TABLE 3

Summary Comparison of Major Plant Species in the Plant Associations of the Study Area

Species	Plant Associations						
	Lower Floodplain	Intermediate Floodplain	Upper Floodplain	Valley Slope Grassland	Valley Slope Shrub	Upland Grassland	Upland Shrub
Trees and Shrubs							
Acer negundo		+					
Amelanchier alnifolia		+					
Elaeagnus commutata					+		+
Prunus virginiana		+					
Rosa woodsii		+					
Symphoricarpos occidentalis		+			+		+
Forbs							
Artemesia frigida				+		+	
Humulus lupulus		+					
Medicago sativa			+				
Polygonum spp.	+						
Graminoids							
Agropyron smithii				+		+	
Bouteloua gracilis				+		+	
Bromus inermis		+	+				
Koeleria cristata				+		+	
Poa pratensis							+
Scirpus americanus	+						
Stipa comata				+		+	
Stipa spartea					+	+	
Typha latifolia	+						

are also present. Blue grama is virtually absent from such sites. In areas with sparse western snowberry cover or with wolf willow as the main shrub component, species characteristic of the upland grassland community become more important.

Approximately 70 species of plants were found as regular members of the upland grass type, however, most of the biomass is produced by only a few species. The following species contributed 75% of the biomass: western snowberry, blue grama, western porcupine grass Stipa spartea var. curtiseta), needle and thread, western wheatgrass (Agropyron smithii), pasture sage (Artemesia frigida) and June grass (Koeleria cristata).

iii) Valley Slope Grassland

The grassland communities of the valley slopes can be divided into two sub-communities on the basis of aspect. The SW and NE exposures represent the warmest and coolest aspects, respectively. On the southwest facing slopes in the Rafferty area, needle and thread is the dominant species, comprising 30% of the total biomass, while western porcupine grass contributes only 3% to the total biomass. In contrast, the comparable values for the northeast facing slopes were 3% and 25% respectively, for needle and thread and western porcupine grass.

iv) Valley Slope Shrubs

In the Rafferty area, western snowberry and wolf willow are the two dominant shrub species on the northwest facing slopes, together comprising more than 40% of the total biomass. These species are almost absent from the southwest facing slopes. Kentucky blue grass, one of the more abundant under-shrub species in the upland community, is absent from the valley slopes. Other differences between the valley slope communities and upland grassland communities include greater densities of western wheatgrass on valley slopes as well as the occurrence of scattered pockets of "true prairie" species which are absent in the upland mixed prairie sites.

v) Lower Floodplain

In the Rafferty area the lower alluvial floodplain community is a disturbed wetland community occurring along the stream channel. No obvious

dominants occur because vegetation is often discontinuous, however, three species occur regularly and are considered characteristic of this type. The three species are three-square bulrush (**Scirpus americanus**), cattail (**typha latifolia**) and smartweeds (**Polygonum spp.**). This type is associated mainly with the frequently flooded zone of the floodplain. It also occurs, but to a lesser extent, at higher locations which receive spring runoff. In such areas a shrub component is normally found.

vi) Intermediate Floodplain

Above the wetland-disturbance community is a more stable vegetation community occupying the intermediate floodplain position. The community is found in a narrow band along the stream channel and inside oxbow meanders in the stretch of the Souris River from the confluence of Roughbark Creek to a point just south of the community of Ralph. Flooding is less frequent and of shorter duration here than in the lower floodplain community. The former is dominated by tall shrubs such as saskatoon berry (**Amelanchier alnifolia**) and chokecherry (**Prunus virginiana**). Manitoba maple may form a significant tree overstory. Green ash (**Fraxinus pennsylvanica**) does not occur as an overstory species in this region but is found in the form of young trees in the understory. American elm trees (**Ulmus americana**), a dominant species in much of the riparian woods downstream from Estevan were not found in this region.

vii) Upper Floodplain

The species composition of the upper floodplain community is highly variable. Much of the area occupied by this community is presently under cultivation for cereal crop and perennial forage crop production. Hay production (mainly brome grass-alfalfa mixtures) is the major use of the upper floodplains of the southern section of the proposed reservoir. The low stream gradient below Dead Lake makes these flats prone to flooding and the areas of natural vegetation remaining reflect this "lowland" or meadow condition. Species such as Kentucky bluegrass (**Poa pratensis**), foxtail barley (**Hordeum jubatum**), western wheatgrass and sedges (**Carex spp.**) found at one site reflect this. In the upper reaches of the proposed reservoir, the upper floodplain is

better drained and has developed a grassland community similar to that of the upland communities, but it has greater densities of western snowberry.

.2 Alameda Region

The proposed Alameda Reservoir is located in the Aspen Grove Ecodistrict of the Parkland Ecological Region (Harris et al 1983). The original vegetation of the general region consists of a mosaic of grassland and aspen woodland. The primary grassland species are rough fescue (**Festuca scarbrella**), northern wheatgrass (**Agropyron dasystachyum**), western porcupine grass (**Stipa spartea var. curtiseta**), and spear grass (**S. comata**). Trembling aspen (**Populus tremuloides**) is the main tree species, with some balsam poplar (**P. balsamifera**) on moister sites. Most of the natural vegetation has been removed for field crop production. The remaining natural vegetation is largely confined to areas that are not suitable for cultivation (because of such factors as stoniness, topography, or drainage).

The floristic list appearing in Appendix 1, contains most of the species expected to occur in the proposed Alameda Reservoir area. A description of the plant associations, based on available literature, is provided below.

i) Floodplain Vegetation

These plant associations are associated with the fluvial deposits along the bottom of the valley of the meltwater channel land system. Along the middle of this zone is the lower floodplain and the channel of Moose Mountain Creek, with open water areas interspersed with marsh environments in areas of reduced gradient and stream flow, and with areas of riparian vegetation. Higher areas more distant from the channel itself represent better drainage and mesic environments which are often cultivated for hay production.

The lower floodplain has been divided into four components: open water along the creek channel; marsh between open water zones riparian graminoid (grass-like plants); forb and low shrub vegetation; and tall shrub and tree cover. Open water zones include the areas of the creek channel with greater depths of water in areas of ponding. Included in this zone are the rooted and floating submergent vegetation species typical of the open water zones of emergent deep marsh (Millar 1976): water milfoil (**Myriophyllum exalbescens**), common bladderwort (**Uticularia vulgaris**) and various pondweed

species (**Potamogeton** spp.). The marsh association represents the coarse-textured emergent growth associated with the margins of the open water zone, or areas of interspersion of deep marsh and shallow marsh Millar 1976) interspersed with surface water and located between open water zones. The deep marsh species include cattail (**typha latifolia**), bulrush (**Scirpus americanus**, **S. acutus** and **S. validus**) and burreed (**Sparganium** spp.) whereas shallow marsh species expected to occur include smartweeds (**Polygonum** spp.), arrowhead (**Sagittaria** spp.), water plantain (**Alisma** spp.), water hemlock (**Circuta maculata**), spike rush (**Eleocharis** spp.) and coarse sedges (**Carex** spp.).

Shallow marsh environments are generally located along the less hydric inner margins of the deep marsh zone, or in shallow depression where surface water is present only until early summer, although saturated soils persist throughout the growing season. Because of the small scale air photos available, areal extent of marsh plant association may be underestimated and considerably more marsh vegetation is probably associated with the open water zone.

The floral composition of the riparian communities along the creek channels of the lower floodplain is more variable and reflects the variation in moisture regime. This plant association was the largest in areal extent in the lower floodplain. The graminoid-forb-low shrub plant association is probably representative of the wet meadow environment (Millar 1976) and is characterized by fine-stemmed grasses sedges, rushes (e.g., balticrush Juncus **balticus**), northern reedgrass (**Calamagrostis inexpansa**), rough hairgrass (**Agrostis scabra**), and various forbs such as sow thistle (**Sonchus arvensis**), marsh hedgenettle (**Stachys palustris**) and wild mint (**Mentha arvensis**). In riparian areas where drainage is sufficient to promote woody growth the development of thickets of shrubs (**Salix** spp.) can be expected and, in some cases, groves of trees (trembling aspen and possibly some green ash and Manitoba maple (**Acer negundo**). These wooded areas are very uncommon within the proposed reservoir area.

Six plant associations have been identified in the upper floodplain including two agricultural types, tilled cropland and hayland in areas of better drainage. The haylands are probably a mixture of brome grass (**Bromus inermis**) and alfalfa (**Medicago sativa**). Grassland associations of the upper floodplain are characterized by mesic, well-drained areas with plant

species such as Kentucky bluegrass (**Poa Pratensis**), foxtail barley (**Hordeum jubatum**), western wheatgrass and various sedges (**Carex** spp.). Shrub associations include a variety of low to medium shrubs including Saskatoon berry (**Amelanchier alnifolia**), chokecherry (**Prunus virginiana**) and in less mesic areas western snowberry (**Symphoricarpos occidentalis**), rose and, to a lesser extent, silverberry (**Elaeagnus commutata**). A mixture of grassland and shrubs is the association of greatest areal extent within the proposed reservoir area. Wooded areas in the upper floodplain may consist of trembling aspen and green ash. The American elm (**Ulmus americana**) is a dominant tree species in the floodplain of the Souris River to the south of this proposed reservoir (Abouguendia **et al** 1982), however, its presence in the Alameda reservoir area has not been established.

ii) Valley Slopes

The valley slopes have several plant associations adapted to the steep slopes with associated excessive drainage and, in some cases, eroding substrates. These slopes are consequently dominated by grassland and grass/shrub associations. The latter is the most prevalent association within the entire proposed reservoir area. Wood areas are restricted almost entirely to portions of eroded coulees leading into the main valleys and agricultural areas are limited to small portions of the lower valley slopes which are used for hayland.

On drier slopes, particularly those warmer slopes with a southern exposure, it can be expected that grasslands will have grass as a dominant species with lesser amounts of western porcupine grass; these proportions will be the reverse for northern slope exposures. Western wheatgrass may also be an important grass species in areas of heavy grazing. During drought periods, blue grama (**Bouteloua gracilis**) may be important.

Shrub plant associations will be dominated by western snowberry and silverberry. The wooded coulee areas are probably composed of stunted trembling aspen with a sparse understory and margin of western snowberry.

iii) Upland Vegetation

Limited upland will be included in the proposed reservoir area since the maximum flood supply level will approach the rim of the valley.

However, in some cases portions of upland will be inundated, including some agricultural areas although these will be very limited in areal extent. Minor amounts of grassland will also be affected; these areas are likely characterized by a spear grass - wheatgrass community, or a spear grass - blue grama - wheatgrass community (Coupland and Rowe 1969). The latter community will be more important in areas of intensive grazing and following a series of dry years. June grass (**Koeleria cristata**) may also be important in some areas. Upland shrub communities will be dominated by western snowberry in more mesic depressions and silverberry in more xeric sites.

The above descriptions of plant association species composition are based upon inference from review of various studies in the region, and a knowledge of species habitat requirements. In order to confirm and expland upon these descriptions however, a field program would be necessary to elucidate species composition and abundance.

6 RANGE CONDITION AND PEAK STANDING CROP

.1 Range Condition

Range condition was calculated by using a guide developed for Coalfields PFRA pasture located 20 kilometres to the east of Estevan (Abouguendia et al. 1982). This pasture is in a washed moraine area similar to that of the present study site and should give accurate range condition ratings for the region.

Rangeland along the Souris River in the area of the proposed Rafferty reservoir was generally only in the upper fair to lower good condition categories (Table 4). This indicates that significant changes in composition of the vegetation community have taken place due mainly to past management practices. Generally, only 40 to 60% of the original vegetation remains with invading forbs, shrubs and grasses making up the balance of the present community.

.2 Standing Crop

The maximum standing crop data from the five sites examined in 1984 varied from 116 to 184 g/m^2 (Table 5). These differences were statistically significant (Abouguendia 1986). A positive correlation between the yield and the range condition has been found. The yield data obtained in this study are

TABLE 4

Range Condition Rating for Selected Grassland Sites
Along the Souris River Valley

Site Number*	Number of Samples per Site	Range Condition Score	Range Condition Class
2	1	40	Fair
3	2	66	Good
4	3	55	Good
5	2	60	Good
6	1	45	Fair
12	1	45	Fair
13	1	40	Fair
14	4	72	Good
15	6	55	Good
16	1	45	Fair
17	1	40	Fair
18	1	45	Fair
19	1	45	Fair
20	2	100	Excellent
21	3	64	Good
23	1	55	Good
24	2	83	Excellent
25	3	29	Fair

* For site locations see Figure 1.

TABLE 5

Maximum Standing Crop for Five Grassland Sites Along
the Souris River Valley

Site Number	Maximum Range Condition Rating	Standing Crop (g/m^2)	95% Confidence Limits
12	45	116	$\pm$30.0
14	72	125	$\pm$34.5
21	64	151	$\pm$27.2
23	55	116	$\pm$19.4
24	83	185	$\pm$20.4

similar to those reported for the Coalfields Community Pasture (Abouguendia et al. 1982).

An equation has been developed by Smoliak et al. (1976) to predict yield on the basis of long-term rainfall averages. Based on this equation, the long-term yield in the Estevan area should average 733 kg/ha. This is substantially lower than the 1000 to 1400 kg/ha determined for most of the rangeland examined in the Study Area. The difference may be due to the more arid climatic conditions of the southwest part of the province for which the equation was developed. The higher evaporation to precipitation ratio in that area would result in lower forage yields for the same precipitation levels.

CONCLUSIONS

Native vegetation occupies most of the proposed development area. The dominant vegetation types are similar to those expected for this ecological zone of southeastern Saskatchewan. None of these types is considered unique or endangered.

The deteriorated range condition observed in the study area appeared to be related to a combination of management and climatic factors. Rangeland of the area is used mainly for grazing by cattle and wildlife. In addition, the natural vegetation has been altered significantly in local areas as a result of agricultural practices, drilling for oil, gravel extraction, pipelines and roadways.

Five plant species considered rare in Saskatchewan occur in a number of locations in the Study Area including two grasses (big bluestem and side-oats grama) and three forbs (Jerusalem artichoke, purple locoweed and blue skullcap). All of these species, except Jerusalem artichoke, have also been recorded along the Qu'Appelle River Valley. The present cover types and vegetation associations however, have been confidently delineated and described on the basis of available literature and aerial photo interpretation.

APPENDIX ONE

A List of Vascular Plant Species Recorded for the Study Area Rafferty and Alameda Reservoirs

Scientific Name	Common Name	Lifeform	Vegetation Type*
Acer negundo	Manitoba maple	Tree	3
Achillea lanulosa	Wooly yarrow	Perennial form	1
Agropyron dasystachyum	Northern wheatgrass	Perennial grass	1,2
Agropyron smithii	Western wheatgrass	Perennial grass	1
Agropyron subsecundum	Bearded wheatgrass	Perennial grass	1,2
Agropyron trachycaulum	Slender wheatgrass	Perennial grass	1,2
Agropyron repens	Quack grass	Perennial grass	3
Agrostis scabra**	Tickle grass	Annual grass	1,4
Alisma plantago-aquatica	Common water-plantain	Forb	3
Allium textile	Prairie onion	Perennial forb	1
Amelanchier alnifolia	Saskatoon berry	Shrub	3
Andropogon gerardii	Big bluestem	Perennial grass	1
Andropogon scoparius	Little bluestem	Perennial grass	1
Androsace septentrionalis	Pygmy flower	Annual forb	1
Anemone canadensis	Canada Anemone	Perennial forb	3
Anemone cylindrica	Long-fruited anemone	Perennial forb	1
Anemone patens var. wolfgangiana	Crocus anemone	Perennial forb	1
Antennaria parvifolia	Small-leaved everlasting	Perennial forb	1
Apocynum cannabinum	Indian-hemp	Perennial forb	3
Artemisia biennis	Biennial wormwood	Biennial forb	1
Artemisia frigida	Pasture sage	Perennial forb	1
Artemisia ludoviciana	Prairie sage	Perennial forb	1
Asclepias ovalifolia	Dwarf milkweed	Perennial forb	1,2
Aster falcatus	White prairie-aster	Perennial forb	1
Astragalus flexuosus	Slender milk-vetch	Perennial forb	1
Astragalus pectinatus	Narrow-leaved milk-vetch	Perennial forb	1
Astragalus triphylus	Cushionmilk-vetch	Perennial forb	1
Beckmannia syzigachne	Slough grass	Annual grass	3,4
Bouteloua curtipendula	Side-oat grama	Perennial grass	1
Bouteloua gracilis	Blue grama	Perennial grass	1
Bromus inermis	Smooth Brome	Perennial grass	3,4,5
Calamagrostis inexpansa	Northern reed-grass	Perennial grass	3
Calamovilfa longifolia	Sand grass	Perennial grass	1,2
Campanula rotundifolia	Harebell	Perennial forb	1
Carex atherodes	Awned sedge	Sedge	3,4
Carex eleocharis	Low sedge	Sedge	1
Carex filifolia	Thread-leaved sedge	Sedge	1
Carex pensylvanica	Sun-loving sedge	Sedge	1
Cerastium arvense	Field chickweed	Perennial forb	1

Scientific Name	Common Name	Lifeform	Vegetation Type*
Chenopodium album	Lamb's quarter	Annual forb	3
Chenopodium glaucum	Saline goosefoot	Annual forb	3
Chrysopsis villosa	Hairy golden-aster	Perennial forb	1
Cicuta maculata	Water-hemlock	Perennial forb	3,4
Cirsium arvense	Canada thistle	Perennial forb	3
Cirsium flodmanii	Flodman's thistle	Perennial forb	1
Cirsium spp.	Thistle	Perennial forbs	3
Comandra pallida	Pale commandra	Perennial forb	1
Convolvulus sepium	Hedge bindweed	Perennial forb	3
Cornus stolonifera	Red-osier dogwood	Shrub	3,2
Crataegus columbiana	Columbian hawthorn	Shrub	2,3
Descurainia sophia	Flixweed	Annual forb	1,3
Distichlis stricta	Salt grass	Perennial grass	1
Echinacea angustifolia	Purple coneflower	Perennial forb	1
Echinocystis lobata**	Wild cucumber	Perennial forb	-
Elaeagnus commutata	Silver willow, Wolf willow	Shrub	2,3
Eleocharis palustris	Creeping spike-rush	Sedge-like perennial	3,4
Elymus canadensis	Canada wild rye	Perennial grass	1,3
Elymus junceus	Russian wild rye	Perennial grass	5
Equisetum arvense	Common horsetail	Perennial forb	3
Equisetum hyemale	Common scouring-rush	Perennial forb	3
Festuca ovina	Sheep fescue	Perennial grass	1
Fraxinus pennsylvanica	Green ash	Tree	3
Gaillardia aristida	Great-flowered gaillardia	Perennial forb	1
Galium boreale	Bedstraw	Perennial forb	1
Galium triflorum	Sweet-scented bedstraw	Perennial forb	3
Gentiana spp.	Gentian	Perennial forbs	1
Geum triflorum	Prairie smoke	Forb	1
Glycyrrhiza lepidota	Wild licorice	Perennial forb	3,4
Grindelia squarrosa	Gumweed	Perennial forb	1,4
Glyceria grandis	Tall manna grass	Perennial grass	3
Gutierrezia sarothrae	Broomweed	Perennial forb	1
Helianthus petiolaris**	Prairie sunflower	Annual forb	-
Helictotrichon hookeri	Hooker's oatgrass	Perennial grass	1
Hordeum jubatum	Foxtail barley	Perennial grass	4
Heuchera richardsonii	Alumroot	Perennial forb	1
Humulus lupulus	Common hop	Perennial forb	3
Juncus balticus	Baltic rush	Perennial forb	3
Juniperus horizontalis	Creeping juniper	Evergreen shrub	1
Kochia scoparia	Kochia	Annual forb	4
Koeleria cristata	June grass	Perennial grass	1
Lactuca pulchella	Blue lettuce	Perennial fob	1
Lepidium sp.	Petter grass	Annual forb	4
Liatrus punctata	Dotted blazing star	Perennial forb	1

Scientific Name	Common Name	Lifeform	Vegetation Type*
Linum lewisii	Lewis wild flax	Perennial forb	1
Lycopus americanus	Water-horehound	Perennial forb	3
Lygodesmia juncea	Skeleton weed	Perennial forb	1
Malvastrum coccineum	Scarlet mallow	Perennial forb	1
Mammilaria vivipara	Cushion cactus	Cactus	1
Medicago sativa	Alfalfa	Perennial forb	5
Melilotus alba	White sweet clover	Biennial forb	3
Mentha arvensis	Wild mint	Perennial forb	3
Monarda fistulosa	Wild bergamot	Perennial forb	1,2
Muhlenbergia richardsonis	Mat muhly	Perennial grass	4
Oenothera nuttallii**	White evening-primrose	Perennial forb	-
Opuntia fragilis	Fragile prickly-pear	Cactus	1
Opuntia polyacantha	Prickly-pear	Cactus	1
Oxytropis splendens**	Showy locoweed	Perennial forb	-
Penstemon sp.	Beardtongue	Perennial forbs	1
Petalostemon purpureum	Purple prairie clover	Perennial forb	1
Phalaris arundinacea	Reed canary grass	Perennial grass	3,5
Phlox hoodii	Moss phlox	Perennial forb	1
Plantago major	Common plantain	Perennial forb	3
Poa palustris	Fowl blue grass	Perennial grass	3,4
Poa pratensis	Kentucky blue grass	Perennial grass	1,2
Polygonum sp.	Smartweed	Perennial forb	3,4
Populus tremuloides	Trembling aspen	Tree	2
Potentilla anserina	Silvrweed	Perennial forb	3,4
Potentilla pensylvanica	Prairie cinquefoil	Perennial forb	1
Prunella vulgaris**	Self-heal	Perennial forb	-
Prunus virginiana	Chokecherry	Shrub	3,2
Psoralea argophyla	Silverleaf psoralea	Perennial forb	1
Ranunculus cymbalaria	Seaside buttercup	Perennial forb	3
Ranunculus flabellaris**	Yellow water-crowfoot	Forb	-
Ranunculus subrigidus**	White water-crowfoot	Forb	-
Ranunculus spp.	Buttercup	Perennial forbs	3
Ratibida columnifera	Long-headed coneflower	Perennial forb	1
Rhus radicans	Poison ivy	Shrub	3
Ribes oxyacanthoides	Bristly gooseberry	Shrub	3,4
Rosa acicularis	Prickly rose	Shrub	3
Rosa arkansana	Prairie rose	Shrub	1
Rosa woodsii	Wood's rose	Shrub	3,2
Rubus strigosus	Wild red raspberry	Shrub	3
Sagitarria cuneata	Arum-laved arrowhead	Perennial forb	3
Salicornia rubra	Red samphire	Forb	4
Scirpus americanus	Three-square bulrush	Perennial forb	3
Scirpus validus	Great bulrush	Perennial forb	3,4
Selaginella densa	Prairie selaginella	Spike-moss	1
Sium suave	Water parsnip	Perennial forb	3

Scientific Name	Common Name	Lifeform	Vegetation Type*
Smilax herbacea	Carrionflower	Prennial forb	3
Smilacina stellata	Star-flowered Solomon's Seal	Perennial forb	3
Solidago canadensis	Graceful goldenrod	Perennial forb	3
Solidago missouriensis	Low goldenrod	Perennial forb	1
Solidago mollis	Velvety goldenrod	Perennial forb	1
Solidago rigida	Stiff goldenrod	Perennial forb	1
Sonchus arvensis	Perennial sow-thistle	Perennial forb	3
Spartina gracilis	Alkali cord-grass	Perennial grass	3
Sporobolis heterolepis	Prairie dropseed	Perennial grass	1
Stachys palustris	Marsh hedge-nettle	Perennial forb	3
Stipa comata	Needle and thread	Perennial grass	1
Stipa spartea	Porcupine grass	Perennial grass	1
Stipa spartea var. curtiseta	Western porcupine grass	perennial grass	1,2
Stipa viridula	Green needle grass	Perennial grass	1
Symphoricarpos occidentalis	Western snowberry	Shrub	2
Taraxacum officinale	Dandelion	Perennial forb	4
Thalictrum occidentale	Western meadow-rue	Perennial forb	-
Thalictrum venulosum	Veiny meadow-rue	Perennial forb	3
Thermopsis rhombifolia	Golden-bean	Perennial forb	1
Thlaspi arvense	Stinkweed	Forb	3,4
Tragopogon dubius	Goat's beard	Perennial forb	1
Triglochin maritima	Seaside arrowgrass	Perennial forb	3
Typha latifolia	Common cattail	Perennial forb	4,3
Urtica dioica	Stinging nettle	Perennial forb	3
Vicia americana	American vetch	Perennial forb	1
Viola rugulosa	Western Canada violet	Perennial forb	3

1 - Grassland (upland and valley slope types)
2 - Shrub
3 - Riparian communities
4 - Slough - meadow complex and lakeshore
5 - Tame pasture, haylands
** - Plant species found in the Midale SDA Community Pasture Study that were not found during the current study.

Source: SRC Background Report No E-902-8-E-85 for SBDA, R.C. Godwin, Z. Abougundia. April, 1985.